A SOUNDPROOFING PANEL

The present invention relates to a soundproofing panel comprising an "exciter" wall for coming into contact with a fluid in which there is a source of noise, and a "receiver" wall for coming into contact with a fluid in which it is desired to attenuate the noise, together with a sound-absorbing intermediate element disposed between the two walls.

BACKGROUND OF THE INVENTION

In the prior art, the intermediate wall is often constituted by a sheet of rubber interposed between two layers of absorbent material, said assembly being sandwiched between the exciter and receiver walls.

The drawback of that solution is that it is not easy to adjust the critical frequency of said wall and that the layers of absorbent material must hold said sheet, thereby limiting the materials suitable for use to those which present sufficient mechanical strength. One known solution consists firstly in covering said wall in metal foil of thickness and mass that are adjusted to adjust stiffness and mass per unit area, and secondly in holding the rubber sheet by fixing it by appropriate means to the exciter wall.

OBJECTS AND SUMMARY OF THE INVENTION

The present invention is based on the idea of suspending the intermediate wall elastically from the receiver wall.

This provides two advantages.

Firstly, the intermediate wall is not linked directly to the receiver wall, thereby improving performance.

Secondly, the intermediate wall in association with the exciter wall constitutes a system of two suspended masses which present a better filtering effect, thereby enabling the panel to provide better soundproofing, at least in a band of frequencies.

The invention provides a soundproofing panel comprising an "exciter" wall for putting into contact with a fluid containing a source of noise and a "receiver" wall for putting into contact with a fluid in which the noise is to be attenuated, the panel further comprising at least one intermediate element between said walls and the intermediate element comprises over at least a portion of its outline at least one element providing elastic coupling between the intermediate element and only the receiver wall.

At least one said flexible element may be a suspension stud of flexible material, in particular of elastomer material. It may also be a flexible wall, in particular an elastomer wall, constituted by one or more segments extending over at least a portion of the outline of the intermediate wall.

The intermediate element may be constituted by wall, e.g. a sheet, in particular an elastomer sheet or an elastomer and metal foil sheet interposed between two layers of sound-absorbing material, the assembly comprising the sheet and the layers of absorbent material being sandwiched between the exciter and receiver walls.

One or more flexible material suspension studs may be disposed along the perimeter of the sheet.

The panel may include a rigid frame secured to the receiver wall of the intermediate sheet, at least one flexible element being fixed between the frame and the intermediate element, e.g. being interposed between the frame and the intermediate element, or indeed between the outline of an opening in the frame and the periphery of the intermediate element.

The panel may include a rigid frame secured to the intermediate element, at least one said flexible element being fixed between the frame and the receiver wall.

In either case, at least one flexible element may be a flexible material suspension stud, or a flexible wall made up of one or more segments extending over at least a

portion of the perimeter of an opening in the rigid frame.

The rigid frame may be made of a material of the honeycomb type presenting an array of cells, in particular hexagonal cells, sandwiched between two rigid plates.

The inside of the frame defines a cavity which may be filled at least in part with a sound-absorbing material, e.g. glass wool.

In the panel, the rigid frame presents one or more openings and the panel includes an intermediate element which covers at least the outer outline of the rigid frame.

In the panel, the rigid frame presents a plurality of openings and the panel has a plurality of intermediate elements each covering one or more openings in the rigid frame.

At least one said opening may be filled with sound-absorbing material.

BRIEF DESCRIPTION OF THE DRAWINGS

Other characteristics and advantages of the invention appear on reading the following description given with reference to the drawings, in which:

- Figures 1 and 2 show two embodiments of a first variant of the invention;
- Figure 3 shows a second variant of the invention, Figure 3a being a section on AA of Figure 3, and Figure 3b being a variant of Figure 3a; and
- Figures 4a and 4b show two variant embodiments of the invention, both including a frame with a plurality of openings.

MORE DETAILED DESCRIPTION

In Figure 1, a composite soundproofing panel comprises an exciter wall 1 disposed on a side where exciter soundwaves (represented by arrows) exist in a fluid 6, and a receiver wall 2 disposed on its opposite side in contact with a fluid 7 in which it is desired to

attenuate noise. In general, the receiver panel 2 is rigid or semi-rigid. In the invention, it may also be a flexible wall, e.g. a sheet of rubber.

An intermediate wall (3, 4, 5) is sandwiched between the exciter 1 and the receiver wall 2 and comprises in succession a first layer 4 of sound-absorbing material which may be fixed to the exciter wall 1, e.g. by adhesive, an intermediate sheet 3, and a second layer 5 of sound-absorbing material which may be fixed to the receiver wall 2, e.g. by adhesive. By way of example, the sheet or plate 3 may be made of flexible or semi-rigid rubber or it may comprise a rubber and metal foil composite. It may be secured to both sound-absorbing layers 4 and 5, e.g. by adhesive. In the invention, the sheet 3 is suspended from the receiver wall 2 by one or more flexible links, e.g. studs 8.

As shown in Figure 2 (fragmentary view), it is possible to make use of conventional rubber suspension studs 8 between the plate 3 and the receiver wall 2. They could be replaced by a suspension using one or more flexible strips so as to distribute the suspension over a larger area.

In the variant shown in Figures 3 and 3a, the intermediate wall is not suspended by a direct link to the receiver wall 5. A rigid frame 10 is used that is secured to the receiver wall 2 and the intermediate sheet or plate 3 is elastically connected to the frame 10, e.g. by a system of elastic studs 8 or via at least one flexible wall 12. This flexible wall 12 is fixed to the inner periphery of the frame 10 (by a system of screws and washers or by spots of adhesive), and to the periphery of the intermediate plate 3. The assembly comprising the wall 2, the frame 10, and the intermediate plate 3 constitutes a cavity which can be filled with sound-absorbing material constituting the layer 5.

In the embodiment of Figure 3b, studs 8 (or one or more flexible strips) are disposed between the

intermediate plate 3 and the frame 10 which is secured to the wall 2, or else studs 8 (or indeed one or more flexible strips) are disposed between the wall 2 and the frame 10 which is secured to the intermediate plate 3. In both cases, the intermediate wall 3 may be flexible, semi-rigid, or rigid.

The frame 10 is designed to have sufficient stiffness and, by way of example, it can be made of a rigid material such as a honeycomb material with an array of cells, e.g. hexagonal cells, sandwiched between two rigid plates.

The elasticity provided by the studs 8 (or by the flexible wall(s) 12 fixed to the frame 10) and also the elasticity of the layers 4 and 5 (generally a compressible material such as fiber glass, felt, or indeed a foam of polyamide, polyimide, polyurethane, or polyethylene) constitute mass-spring coupling parameters between the intermediate wall 3 and the receiver wall 2. The elasticity of the studs 8 or of the flexible wall(s) 12 determines the range of frequencies in which the desired effect is obtained.

The frame 10 may have a plurality of openings, e.g. an array of openings 15 as shown in Figures 4a and 4b. In Figure 4a there is a single intermediate plate 3 which covers the frame 10 and thus covers its openings.

In Figure 4b, there are a plurality of intermediate plates 3, e.g. one intermediate plate 3 per opening.

At least one opening 15 may be filled with sound-absorbing material.